

engineering and constructing a better tomorrow



Mr. David Adams MassDEP Northeast Region 205B Lowell Street Wilmington, Massachusetts 01887

December 15, 2006

Dear Mr. Adams:

Subject:

Calcium Sulfate Landfill Submittals

51 Eames Street, Wilmington MA

On behalf of Olin Corporation, please final enclosed for your review two copies of a closure certification letter for the Calcium Sulfate Landfill located at 51 Eames Street, in Wilmington, MA.

Also included for your review is a Draft Post Closure Monitoring Plan. When you have had an opportunity to review these documents, it would be my pleasure to meet with you and Steve Morrow at your office to answer any questions and discuss your comments. Based on your input, we will revise the draft and submit a final Post Closure Monitoring Plan. Subsequently, Olin will put in place an appropriate financial assurance mechanism for post closure care, and record a notice of landfill operation in the registry of deeds.

If you have any questions in the interim, please feel free to contact Steve Morrow with Olin Corporation at (423)-336-4511.

Sincerely,

cc

Peter Thompson Project Manager

> Mr. Steve Morrow - Olin File

DRAFT Calcium Sulfate Landfill Post Closure Monitoring Plan

51 Eames Street Wilmington, Massachusetts

Prepared by:



MACTEC Engineering and Consulting, Inc. 511 Congress Street Portland, Maine 04101

6300060011/ Task 80.14

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Calcium Sulfate Landfill Post Closure Monitoring Plan MACTEC Engineering and Consulting, Inc., Project 6300060011/80.14

December 2006 Draft

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1.0 Introduction

This Post Closure Monitoring (PCM) Plan for the Calcium Sulfate Landfill (CSL) is being submitted in support of the closure documents discussed with the Massachusetts Department of Environmental Protection (MADEP) in 2004 concerning a closure that formally occurred in 1988 under a MADEP approved (MADEP, 1988) closure plan (E.C. Jordan, 1986). The CSL is located upon a portion of land owned by Olin Corporation at its 51 Eames Street property, in Wilmington, Massachusetts. The landfill was permitted in 1974 (Board of Health, 1974) and operated between 1975 and 1987 for the disposal of approximately 37,000 cubic yards of gypsum, a calcium sulfate mineral. The approved and constructed cover system consists of a six inch thick low permeability soil layer and a three inch topsoil-vegetative support soil layer, which supports a very thick grass and clover cover. Groundwater data collected since 1988 at CSL wells is included in this PCM Plan and forms the basis for the proposed groundwater monitoring plan.

1.1 Purpose and Scope

The purpose of this PCM Plan is to identify the tasks and activities necessary to monitor the long-term effectiveness of the CSL closure and to verify that public health, safety, and the environment are adequately protected. This PCM Plan was prepared in accordance with 310 CMR 19.140(4). The post closure period normally lasts for at least 30 years, unless a waiver of this requirement is approved by the MADEP (310 CMR 19.142). Monitoring, inspection and maintenance of the CSL will be conducted in accordance with the requirements of this document, upon MADEP approval. Olin is requesting that the 30 year Post Closure monitoring period commences in 1988 consistent with the date of closure, and in consideration that Olin has maintained and monitored the facility since that time.

This landfill PCM Plan describes:

- annual maintenance and inspection of the landfill, including annual inspection
 of the cap, monitoring wells, and access roads, and periodic mowing of the
 vegetation to prevent the growth of trees;
- groundwater monitoring;
- maintenance of survey benchmarks,
- maintenance activities and corrective measures to be undertaken should inspection data indicate they are necessary,
- biennial reporting requirements, and
- anticipated annual costs to conduct PCM activities.

This document is organized as follows:

Section 1.0 presents the purpose and scope of this PCM Plan and site background which includes a facility description.

Section 2.0 presents regulatory requirements and the scope of this PCM Plan.

Section 3.0 discusses the inspection plan for the landfill cover, monitoring wells, and access roads.

Section 4.0 discusses the results of groundwater monitoring that has occurred since 1988 and presents the proposed monitoring plan for post-closure groundwater sampling, analysis, and biennial reporting.

Section 5.0 presents the nature of potential maintenance activities that may be undertaken at the site.

Section 6.0 presents estimated annual costs for PCM activities.

1.2 Site Background

1.2.1 Site Description

The CSL, shown in Figure 1, is located at the southwest corner of the 51 Eames Street, Wilmington, Massachusetts property (the Site). The CSL location and plans were approved by the Massachusetts Department of Public Health (MADPH) on January 16, 1974, and the Town of Wilmington Board of Health on October 11, 1974. The Site was operated as a mono-fill throughout it operational history, from 1975 to 1987, receiving fill material consisting of fine-grained gypsum sediment. The CSL is approximately 2.5 acres in size with a volume of approximately 37,000 cubic yards. In 1987 the CSL was capped, covered with top soil, and seeded with final closure status requested in 1988.

The CSL is located immediately north-west of the Woburn Sanitary Landfill (WSL). The WSL is approximately 40 acres in size. Both the CSL and WSL lie within the confines of the Mystic River watershed basin. Groundwater flow in the vicinity of the CSL is toward the southwest, with a component of flow toward the east.

2.0 Regulatory Requirements

Inspection, monitoring, and maintenance activities for the CSL shall be performed in compliance with an approved closure agreement with MADEP.

2.1 Inspection, Monitoring, and Maintenance Activities

Regulations applicable to inspection, monitoring, and maintenance activities at the CSL include:

310 CMR 19.142 - Landfill Post-closure Requirements

2.2 Health and Safety

Personnel shall at all time follow safe working practices while conducting post-closure activities. Hazards associated with inspection, monitoring, and maintenance activities include basic physical hazards associated with slips, trips, and falls, and operation of heavy equipment, including tractor-mounted lawn mowers.

Environmental monitoring of the CSL will include collection of groundwater samples which, based on many years of results, do not contain hazardous substances. Therefore groundwater sampling will be conducted in modified level D protective personnel equipment (PPE) including nitrile or latex gloves, safety glasses, and steel toed boots.

The CSL does not contain wastes that would normally be expected to generate methane, hydrogen sulfide or other potentially hazardous gases, and monitoring for explosive or oxygen deficient environments is not required.

3.0 Inspection Plan

The following subsections discuss the inspection plan for the CSL. The inspection plan provides the procedures for visual inspection of the landfill cap, monitoring wells, and access roads.

Components of the inspection plan include:

- visual inspections, and
- reporting

3.1 Cover System Inspection

Visual inspection shall be performed to identify evidence of:

- erosion of the cap system and drainage features;
- differential settlement resulting in soil cracking or ponded water;
- seeps;
- animal burrows;
- vegetative distress;
- presence of rooted species (trees and shrubs) on the cap;
- damage to monitoring wells;
- · deteriorating equipment such as fencing, gates, and drainage structures; and
- deterioration of access roads.

Olin personnel have monitored and maintained the CSL since 1988. Site inspections shall be conducted by Olin personnel under the review of a third party consulting Massachusetts Registered Professional Engineer, or conducted by another qualified professional approved by the Department. Observations shall be recorded in writing as quantitatively as is practical, and photographs will be taken as a supplement if deemed appropriate by the inspector. The estimated length, width, depth, and location of any observed erosion channels, depressions, or seeps shall be recorded. The locations of animal burrows will be noted if observed. Vegetative stress shall be described according to location, aerial extent, and nature of distress. The presence and location of rooted species, such as trees and shrubs, shall be noted. The condition of the access roads, the benchmark location, drainage ditches, posts, gates, locks, and signs shall be observed. The condition of the groundwater monitoring wells shall be evaluated at the time of sampling and during the annual inspection. Potential causes of any damage will be noted. and repair and preventative measures shall be recommended. Observations will be summarized in a letter report following each inspection and retained for inclusion in the Biennial Report. The inspector shall fill out an inspection form, an example of which is provided in Appendix A.

The CSL does not have a leachate collection system and there are no culverts. The cap is elevated above surrounding grades and is separated from the WSL by a drainage swale. Since the CSL is a monofill of calcium sulfate and has no organic content, it does not

generate gases. Therefore the cover system was not designed and was not constructed with passive gas vents or gas recovery wells. The current vegetative cover is thick, healthy and shows no signs of past or existing stress or degradation from gas migration or the presence of leachate seeps.

If conditions detrimental to the cover system and drainage structures are observed, then an assessment of the cause of those conditions will be undertaken by the inspector, in consultation with Olin to identify appropriate corrective measures in accordance with Section 5.0, the Maintenance Plan.

3.2 Inspection Schedule

The vegetative cover over the low permeability cap has been well established and has been mowed annually at the CSL for nearly 16 years, and currently shows no signs of soil loss, erosion, slumping, animal borrow, degradation or stress. Visual inspections will therefore be conducted annually, preferably in the spring of each year, for the duration of the post closure period. A spring inspection will allow any observed deficiencies to be reported to the MADEP, if required, and any corrective measures implemented during appropriate weather conditions in the summer or fall months.

3.3 Reporting

Consistent with 310 CMR 19.142(6), during the post closure monitoring period, results of the landfill inspections shall be documented in a letter report and submitted to MADEP every two years as part of the Biennial PCM Report. The letter report will contain a narrative description of the inspection activities, conditions observed, and any maintenance activities that occurred over that period. Additional discussion of the reporting requirements is contained in Section 4.3

4.0 Groundwater Monitoring Plan

The following section presents the results of groundwater monitoring that has occurred at the CSL monitoring well locations since 1981 and proposes a monitoring well network and monitoring strategy for the PCM period. The monitoring plan provides the procedures for sampling, analysis, and reporting of CSL groundwater conditions.

As stated previously, the CSL does not contain municipal solid waste or other organic waste that would generate gas by biological decomposition, and accordingly, the CSL closure was not designed with a gas venting system. There are no streams or other natural surface water bodies in immediate vicinity of the CSL. Two stream segments, named the Ephemeral Ditch and the South Ditch, are located within the 51 Eames Street property, are located north of the CSL. These surface water bodies will be monitored under the CERCLA program. Therefore, the environmental monitoring for the CSL PCM Plan is restricted to groundwater. The monitoring program described herein pertains to wells associated with the CSL and which are located along all four sides of the perimeter of the landfill. Other groundwater monitoring wells currently exist both on and off the 51 Eames Street Property which will also be monitored under the CERCLA program. Since these other groundwater and surface monitoring will be conducted under CERCLA, the monitoring program proposed at the CSL will be restricted to wells installed at the landfill to avoid duplication of sampling efforts.

4.1 Groundwater Monitoring Data

Table 1 presents an analyte sampling matrix that summarizes the groundwater monitoring program that has occurred at CSL between May 1988 and March 2004. The matrices indicate the number of individual analytes within a parameter type (e.g., volatile organics) that were analyzed during each unique sampling event which is identified by sample date. The locations of these wells are shown on Figure 2.

Table 2 presents analytical results for all detected analytes groundwater monitoring wells at the CSL. The table compares results to water quality standards including Federal and State Maximum Contaminant Levels (MCLs), Secondary Maximum Contaminate Levels (SMCLs), and Massachusetts Contingency Plan (MCP) drinking water guidelines (ORSGs), the latter two of which are recommended guideline values for aesthetic quality of drinking water (color, odor, and taste). These aesthetic guideline values are not based on human health effects.

In 1999 Olin conducted a geochemical assessment of the groundwater data to discriminate between groundwater related to the CSL and other potential sources of groundwater impacts such as the WSL which abuts the CSL (Geomega, 1999). Since the CSL is a monofill of calcium sulfate mineral precipitates (gypsum), general water quality impacts should be primarily soluble calcium and sulfate in a stochiometric ratio consistent with mineral chemical composition and solubility. In it's report, Geomega indicated that groundwater concentration ratios for calcium to sulfate should approach the theoretical stochiometric ratio of 0.4: 1.0 expected from the leaching of gypsum.

Evaluation of calcium to sulfate ratios indicates that CSL impacted groundwater is limited to the immediate vicinity of the CSL. When both calcium concentrations and calcium to sulfate ratios are included in this evaluation, the clearly impacted CSL wells include SL-5, and SL-6.

4.1.2 Summary of Geologic and Hydrologic Conditions

The CSL groundwater monitoring wells were installed in November, 1987 along all four sides of the landfill and include SL-1D, SL-2, SL-3, SL-4, SL-5, SL-6, SL-7 and SL-8 (Figure 2). The wells on the western side of the site (SL-1, and SL-2) encountered bedrock from 12 to 13 feet below ground surface (bgs) and were cored to approximately 15 feet. Bedrock is overlain by medium dense to dense fine sands, and coarser sands and gravel with some inorganic silt. The wells are screened over a ten foot interval in the shallow bedrock and overlying sand. The well on the southern side of the CSL, SL-3, encountered bedrock at 19 feet, which is overlain by similar sands and gravels. Bedrock was cored at this location to 21 feet and a ten foot well screen was set from the bottom of the boring. SL-4 was drilled to the east of SL-3 and encountered bedrock at 13 fewet, but was dry. On the eastern side of the CSL, SL-5 and SL-6 encountered bedrock at 13 feet and 19 feet bgs respectively. Approximately 2.5 to 2.0 feet of bedrock was cored in each boring respectively, and a ten foot well screen set from the bottom of the boring into the overlying fine to medium sands and gravels. Along the northern side of the landfill the boring for SL-7 encountered bedrock at 7 feet and was cored to 10 feet bgs. Bedrock here is overlain by fine sands, and medium to coarse gravels. A five foot well screen was installed from the bottom of the boring up into the sands and gravels. SL-8 encountered bedrock at three feet bgs, overlain by fine to coarse sands. The boring was cored to six feet and a five foot well screen was set from the bottom of the boring.

Based on observed bedrock elevations and bedrock exposures to the north of SL-8, and to the south east of the CSL, a bedrock ridge is interpreted to run under the landfill with the axis aligned from the southeast to northwest corner. Bedrock slopes off to the northeast and to the south west which influences the thickness of overburden deposits and the directions of groundwater flow in vicinity to the site

The most comprehensive groundwater elevation data sets for the CSL wells collected over ten years from 1988 to 2001 are provided in Table 3. These data indicate that the highest groundwater table elevations occur in the vicinity of SL-8 and SL-7, which are upgradient to the CSL. A broad groundwater divide or small mound may extend a short distance south under the western central portion of the landfill resulting in a somewhat radial groundwater flow pattern from the north end of the CSL. The interpreted groundwater flow direction from SL-8 has a component to the east and southeast toward SL-6 and SL-5, south toward SL-3, and southwest toward SL-1D, and SL-2.

4.1.3 Summary of Individual Groundwater Monitoring Well Analytical Results

The analytical results for the CSL monitoring wells are discussed below with respect to regulatory standards and guidelines. This discussion is focused on inorganic and organic

analytes that have a regulatory guideline, have been detected and have exceeded a regulatory guideline which in the majority of instances includes the secondary water quality guidance values. These data are discussed from upgradient to down gradient locations.

Upgradient CSL Well Locations

Groundwater from SL-8 was sampled and analyzed in 1998 for sulfate, which was detected at a concentration of 40.3 mg/L, and was well below the SMCL of 250 mg/L.

Groundwater from SL-7 was also sampled and analyzed in 1998 for sulfate, which was detected at a concentration of 10.4 mg/L, and was well below the SMCL of 250 mg/L.

CSL Perimeter Groundwater Monitoring Well Locations

Groundwater from SL-1D was sampled between the years of 1988 and 2004. Analysis has included volatile organic compounds (VOCs), semi-volatile organics compounds (SVOCs) pesticides and polychlorinated biphenyls (PCBs), EPA target analyte list metals, other inorganics, and field parameters. Sulfate, dissolved aluminum, and manganese have been detected above SMCLs. In 1992 aluminum was detected between 0.13 and 0.28 mg/L which was above the SMCL of 0.05 mg/L. In 1998, manganese was detected at a concentration of 0.065, which was above the SMCL of 0.05 mg/L. Sulfate was detected once at 330 mg/L in May of 1988 which was above the SMCL of 250 mg/L. Since December 1989, sulfate has remained below the SMCL.

Groundwater from SL-2 was sampled between the years of 1988 and 2004. Analysis has included a short list of VOCs and SVOCs, metals and inorganics. Total chromium and bis(2-ethylhexyl) phthalate (BEHP) were each detected once above MCLs. In November 1989 total chromium was reported at 0.51 mg/L and was above the MCL of 0.1 mg/L. BEHP was reported at 0.007 mg/L, which was above the MCL of 0.006 mg/L. BEHP is also a common sampling and laboratory contaminant. Sulfate has also been detected, but at concentrations below SMCLs.

Groundwater from SL-3 was sampled between the years of 1988 and 1998. Analysis has included a short list of VOCs and SVOCs, metals and inorganics. Sulfate has consistently been detected in a concentration range from 460 to 790 mg/L which is above the above SMCL of 250 mg/L. Dissolved manganese was detected at a concentration of 0.623 mg/L in April 1998, which was above the SMCL of 0.05 mg/L.

Monitoring well SL-4 was dry and therefore was not sampled historically.

Groundwater from SL-5 was sampled between the years of 1988 and 1998. Analysis has included VOCs, SVOCs pesticides and PCBs, EPA target analyte list metals, other inorganics, and field parameters. Sulfate, manganese, dissolved manganese, total aluminum, and iron have been detected above SMCLs, nickel detected above the MCL and sodium detected above the Massachusetts Contingency Plan (MCP) drinking water

guidelines (ORSGs). Sulfate concentrations ranged from 1,100 to 2,400 mg/L. In December 1991 total aluminum was detected at 12 mg/L which is above the SMCL of 0.05 mg/L, total iron was detected at 0.425 mg/L which was above the SMCL of 0.3 mg/L and dissolved manganese was detected at 0.486 mg/L which was above the SMCL of 0.05 mg/L. Sodium was detected in April 1998 at a concentration of 47.8 mg/L which was above the ORSG of 20 mg/L.

Groundwater from SL-6 was sampled between the years of 1988 and 1998. Analysis has included VOCs, SVOCs pesticides and PCBs, EPA target analyte list metals, other inorganics, and field parameters. Sulfate, chloride, TDS, dissolved aluminum, manganese were detected above SMCLs and sodium was detected above the ORSGs. Sulfate was detected above the SMCL of 250 mg/L at concentrations ranging from 370 to 1,500 mg/L. Chloride was detected above the SMCL of 250 mg/L twice in 1992 at concentrations of 400 and 680 mg/L. Dissolved aluminum exceeded the SMCL during the same period. Chloride was below SMCLs in all other samples analyzed from 1988 to 1998. TDS was detected above the SMCL of 500 mg/L at a concentration of 2,050 in 1998. In 1998, and 1992 dissolved manganese was detected three times above the SMCL of 0.05 mg/L at concentrations ranging from 5.02 to 11 mg/L.

Monitoring data from perimeter wells indicate that groundwater impacts are principally related to dissolution of calcium sulfate (gypsum). Organic compounds (VOCs, SVOCs) are not present with the exception of low level detections of BEHP.

4.2 Proposed Post Closure Groundwater Monitoring Program

An appropriate long-term monitoring program well network normally includes upgradient, and down gradient wells. The historical groundwater monitoring data set for the CSL is sufficient to select appropriate analytes, parameters, and associated analytical methods for groundwater monitoring and define which wells should be included in a monitoring well network. This data set is consistent with the disposal history of the site which was restricted to calcium sulfate (gypsum) residuals. The following subsections propose a long term monitoring program which includes discussion of the monitoring well network, a sampling and analysis program, sampling schedule, data management, data evaluation and reporting requirements.

4.2.1 Monitoring Well Network

On the basis of historical groundwater data results, and conclusions from the 1999 geochemical investigation, the following monitoring wells are recommended for the long-term monitoring program:

Upgradient Wells

SI-8

SL-7

Down Gradient Wells

SL-1

SL-2

SL-3

SL-5

SL-6

4.2.2 Sampling Procedures

Samples will be collected, to the extent practical, in accordance with the EPA Region I Low Stress (low flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells, (USEPA, 1996). A number of the monitoring wells have short screen lengths (five feet) and limited saturated thickness during seasonal low water table conditions, due, in part, to the shallow depth to bedrock. The overburden aquifer likely has low to moderate hydraulic conductivities (fine sands, with some medium to coarse sands) and the minimum drawdown requirements of the low flow procedure may not be practical to achieve in some wells, at certain times of the season. In the event the minimum drawdown criteria cannot be achieved at the lowest obtainable flow rates an alternative sampling approach may be used. This alternative approach would include purging the well dry and allowing it to recharge then collecting the water from the recharged groundwater, without recording in-line flow through cell water quality monitoring parameters. Under standard low-flow procedures, field parameters (pH, specific conductance, oxidation-reduction potential, dissolved oxygen, and temperature) will be measured through a low flow cell, and recorded at five minute intervals. Turbidity will be measured with a separate instrument from a "T" located before the inlet to the flow through cell. When these water quality parameters are stable (within 10% in three sequential measurements), the groundwater sample will be collected, prior to entering the low flow cell.

Under the low flow procedure, samples will be collected through a dedicated sample tube placed in the center of the well screen using a peristaltic pump (Geopump). Each well currently has a dedicated sampling tube. Dedicated sampling equipment will not need to be decontaminated. Non-dedicated sampling equipment, if used, will be cleaned with a non-phosphate detergent (liquinox), and rinsed with de-ionized (DI) water. One rinse blank sample would be collected for each analyte group during each sampling event, if non-dedicated sampling equipment is used.

4.2.3 Analytical Program

Under authority of CMR 19.132 (1)(h) the MADEP may approve an alternate list of monitoring parameters based on review of past monitoring results or other relevant information. Prior sampling at the CSL has included analysis of VOCs, SVOCs, pesticides, PCBs, metals and other inorganics. The CSL is a monofill of calcium sulfate mineral precipitates, and is not a source of organic contaminants. Analysis of samples for organic compounds is therefore not proposed.

Historical data indicates that groundwater at the CSL has exceeded the SMCL for sulfate, calcium and certain metals. These parameters comprise the proposed monitoring analytical program.

An initial year of quarterly sampling would be conducted to re-establish a seasonal baseline data set for the proposed monitoring wells. This initial quarterly sampling program will include analysis for the following parameters:

Total dissolved solids; Alkalinity; Sulfate; Chloride;

Dissolved metals including calcium (Ca), Sodium (Na), aluminum (Al), manganese (Mn), iron (Fe), chromium (Cr), and nickel (Ni); and Total metals including Ca, Al, Mn, Fe, Cr, and Ni.

After the first year of monitoring the data will be reviewed and any revision to the sampling frequency and parameter list would be proposed as discussed in Section 4.5.

These parameters will be analyzed by a Massachusetts certified laboratory using the following methods, with the following container, preservation and hold time requirements. Practical quantitation limits or laboratory reporting limits that meet or are below the state or federal drinking water standards, MCL or other applicable standards established in a permit will be achieved for each analyte tested.

Parameter(s)	Analytical Method(s)	Containers and Preservation	Hold Times
Alkalinity	Standard Method 2320B	250 ml Poly 4°C	14 days
Total Dissolved Solids;	Standard Method 2540C	125 ml Poly 4°C	7 days
Sulfate/Chloride	300.0, 375.2	125 ml P 4°C	28 days
Metals (Ca, Al, Mn, Na, Fe, Cr, Ni)	6010B	500 ml Poly HNO ₃ to pH<2	6 months
Water Quality Parameters (in-situ), including: pH, temperature, turbidity, specific conductance, and dissolved oxygen	Field measured in a flow through cell using a Horiba U22 or equivalent meter. Turbidity by a separate Hach 2100P / Lamotte or equivalent instrument from "T" in sample tube prior to flow through cell.	NA	Analyze Immediately

Level II data packages will be requested from analytical laboratory which provides the data reports that support QA/QC reviews specified in the MADEP MCP data enhancement program.

Sampling Quality Assurance and Quality Control (QA/QC) shall include collection of field duplicate samples at a frequency of 20 percent, per parameter analyzed, and at a minimum one per sampling event. A separate sample for a laboratory matrix spike sample will be collected at the same frequency for inorganic analytes. A temperature blank will be provided in all sample cooler shipments.

4.2.4 Monitoring Schedule

Under authority of CMR 19.132 (1)(d) the MADEP may approve an alternate schedule for groundwater monitoring. Sampling and analysis of groundwater from the monitoring well network presented in Subsection 4.2.1 shall be conducted on a quarterly basis for the first year and on an annual basis thereafter at the acceptance of the MADEP. The first year of quarterly monitoring shall be used to re-establish baseline conditions and to ascertain if seasonality effects are apparent in the data set. During this first year of sampling, both unfiltered and filtered (0.45 micron filter) samples will be submitted for metals analysis to validate the effectiveness of low flow sampling at these specific monitoring wells.

The second and subsequent year annual monitoring events shall target groundwater conditions that exhibited maximum analyte concentrations from the baseline quarterly sampling. A review of the first year of quarterly data will be conducted to evaluate the comparability of filtered versus unfiltered sample data. Subsequently a recommendation will be made to the MADEP to either continue both protocols or discontinue one procedure after the first year of groundwater monitoring.

4.2.5 Sample Records, Analysis Records and Data Reporting

Field sampling records will be maintained in a field sampling logbook. For each sample collected and analyzed, the date, time and location will be recorded as well as any other applicable field observations (weather conditions, visual observations of water (clarity etc)). A field data record for low flow sampling will also be filled out as part of the sampling documentation for reporting purposes. Each sample will be provided with a unique identifying number according to the general format below. Samples will be shipped under chain of custody. An example field data record is provided in Appendix B. Monitoring well construction logs are provided in Appendix C.

Sample identification will generally adhere to the following 14-digit system:

Digits 1,2,3,4 Sample location. Four digits excluding dashes, (e.g., SL-05).

Digits 5,6,7,8,9,10 Sample date. Six digits excluding colons in a MM:DD:YY format.

Digits 11, 12, 13 Sample type. Field sample =XXX, QC samples as follows: DUP = field duplicate, MSD = matrix spike duplicate,

Equipment Rinse Blanks, if required, will be treated as a Sample Location (e.g., EB-01) followed by the sample date, and the sample type CSL as a location identifier.

Level II laboratory packages will be requested from the laboratory to support review of the groundwater analytical data in accordance with requirements specified in the MCP data enhancement program. Upon receipt, the data from the laboratory will be reviewed to verify laboratory internal QA/QC data quality indicators. Reviewed data will be maintained by Olin for storage and future retrieval for reports.

4.3 Post Closure Monitoring Reports

Consistent with 310 CMR 19.142 (6), the Owner, or successors, or assigns, shall submit a report every two years during the post closure period which describes the results of landfill inspection and groundwater monitoring program. The report will describe results of visual inspections as described in Section 3.1, and any corrective actions for observed deficiencies.

Consistent with 310 CMR 19.132 (1)(f-g) reporting of groundwater monitoring results shall include a tabulated summary of data with a discussion of the results and a trend analysis. Any issues of concern will be identified. Monitoring data shall be tabulated in tables, discussed and plotted to indicate any data trends. The report will include a site plan showing sampling locations, interpreted direction of groundwater flow, and distribution of contaminants, if present above MCLs. The report will include all field QA/QC information, and copies of the chain of custody forms. Static water table elevations and bottom of well elevation at the time of sampling will be provided. After the first year of quarterly sampling, the data will be evaluated to determine if the low flow total metals data is consistent with the (filtered) dissolved metals results. If both data sets are in agreement a letter report shall be prepared and submitted to the MADEP with a request to discontinue one of the two protocols (filtered vs. unfiltered).

5.0 Maintenance Plan

Items identified during the site inspection requiring corrective maintenance shall have repairs commence within 60 days of the inspection date, provided weather or access do not restrict repair activities and the scope of repairs can reasonably be started or accomplished within the 60-day period. Reports of maintenance activities will be provided to the MADEP with the Post Closure Monitoring Biennial Report.

5.1 Cover Maintenance

The vegetative cover shall be maintained to achieve the objectives of preventing the growth of deep rooted, woody species, and to encourage the development of good grass growth. As has occurred since 1988, cover maintenance shall include mowing or hand culling of woody plant species at an appropriate frequency to achieve these objectives.

5.1.1 Reseeding of Deficient Areas

Areas noted during inspections to have poor vegetative growth shall be repaired and reseeded in accordance with the seed mix specified below and application methods according to Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas (MADEP, 2003), or as accepted by the MADEP.

Seed Type	PLS* per acre (lbs.)
Tall Fescue (Alta or K31)	20
Perennial Ryegrass (Manhattan)	20
White Clover	15
Red Fescue (creeping)	30
*PLS – Pure live seed by weight	
Spring seeding (May 15 to June 15) is accep-	table
Fall seeding (September 1 to September 15)	

5.1.2 Repairs to Cover System

Animal burrows into the vegetative soil will be filled and seeded in accordance with above seed mix. Burrows which penetrate the low permeability layer will require replacement in kind. Elimination of animal problems may be accomplished through trapping and relocating or extermination. To date, animal burrows have not been observed at the CSL.

Erosion of the soil cover or locations of ponded surface water on the cap shall be repaired as needed and in a manner that provides a long-term solution to such damage. The activities required to repair erosion of the cover will depend on the extent of damage. At a minimum, an eroded area shall be excavated to the vertical and lateral extent of the

lowest affected cover component and reconstructed. The disturbed area shall then be mulched and seeded in accordance with Subsection 5.1.1 above.

5.2 Roadway Maintenance

Periodic maintenance of the access roads may be necessary. Drainage ditches will be kept free-draining, and the effects of any unauthorized use of the roadside, shall be repaired as necessary. Regrading and/or placement of additional aggregate base material may be necessary at some time in the future, though it is not anticipated at this point in time. Substantial erosion or deterioration of the road bed and road-side drainage ditches would require reconstruction efforts. Repairs to the roadbed shall be consistent with standard industry practices and the grades and slopes of the surrounding areas.

5.3 Drainage Structure Maintenance

If maintenance of drainage features is required, including road-side ditches, as identified during site inspections, repairs will be conducted such that the final grades of all repaired areas conform to the grades and slopes of the surrounding areas.

5.4 Gated Access Maintenance

Fence maintenance will include oiling gate hinges and replacing locks on an as needed basis. Holes in the chain-link identified during the monitoring program will be repaired as needed. Minor erosion rills or animal burrows beneath the fence will be identified and repaired as necessary.

6.0 Post Closure Monitoring Costs

Olin has a full time, on-site maintenance staff of two individuals at the 51 Eames Street Facility. These personnel, who are appropriately trained to conduct environmental sampling, are available at no additional labor cost to Olin to conduct all aspects of the annual maintenance, groundwater monitoring at the CSL, and report preparation. These individuals are supported by professionals employed by Olin's environmental management staff. Olin owns all necessary equipment to mow the cover and sample the monitoring wells. Olin proposes to use these staff and resources to conduct post closure monitoring and inspections. Other than the soil cover system, the landfill does not have any engineered systems requiring maintenance. A third party Massachusetts Professional Engineer shall be retained by Olin to review PCM activities, and biannual reports, unless another professional is otherwise approved by the MADEP to perform these functions on behalf of Olin.

The annual costs which currently require funding by Olin to conduct post closure monitoring and reporting include:

- Laboratory costs for sample analysis, and
- Labor and other direct costs for third party review of the inspection and biennial reports; and
- QA/QC review of laboratory data.

The roads, surface water drainage swales, monitoring wells, fence, and gates were constructed in 1988, and have not required any substantive maintenance costs to date beyond mowing. Due to the quality of the road beds and the current good condition of the fencing and the very limited traffic and use they endure, future road or fence maintenance is not expected as an ordinary cost. The landfill cover is well vegetated and surface water run-off does not contain sediment that would build up in the drainage swales and require periodic dredging or maintenance. Furthermore, the slopes of the CSL are generally gentle, short in slope length, and are able to withstand prolonged periods of heavy precipitation (such as in Spring 2006) without being subject to erosion problems. Therefore, repair of slopes and ditches is not anticipated as an ordinary annual maintenance cost.

The estimated annual costs for monitoring and maintaining the CSL over the next twelve years are provided in Table 4. The costs are summarized as an average annual cost (\$3,596) and a total cost (\$43,152) in current dollars. Olin will retain records of the CSL post closure monitoring and maintenance costs and summarize the PCM costs in the biannual PCM report.

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- Geomega, 1999. Olin Wilmington Technical Series, IV. Geochemical Discrimination Between Groundwater Emanating from the Calcium Sulfate and Woburn Sanitary Landfills, Prepared for Olin Corporation, Wilmington, MA Facility, February 10, 1999.
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GLOSSARY OF ACRONYMS AND ABBREVIATIONS

Al Aluminum

BEHP bis2-ethylhexylphthalate bgs below ground surface

BWP Bureau of Waste Prevention

BWSC Bureau of Waste Site Cleanup

Ca Calcium
Cr Chromium

CSL Calcium Sulfate Landfill

Fe Iron

MADEP Massachusetts Department of Environmental Protection

MADPH Massachusetts Department of Public Health

MCLs Maximum Contaminant Levels MCP Massachusetts Contingency Plan

Mn Manganese

Ni Nickel

ORSG MCP Drinking Water Guidelines

PCM Post Closure Monitoring PE professional engineer

PPE protective personnel equipment

QA/QC Quality Assurance and Quality Control

SMCLs Secondary Maximum Contaminate Levels

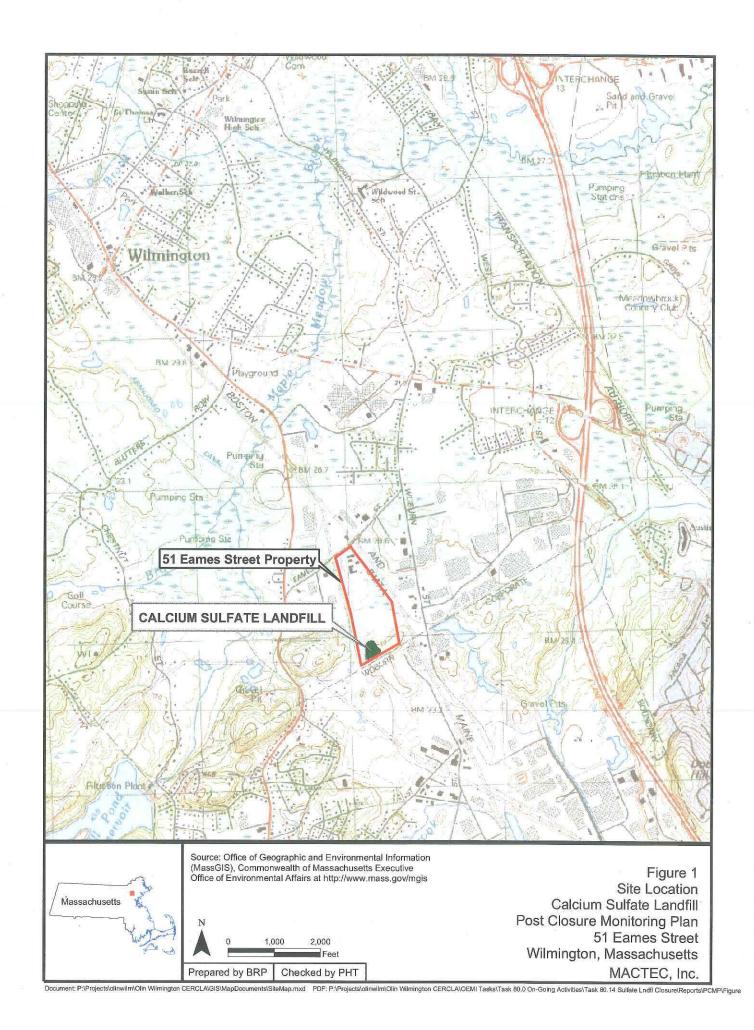
the Site 51 Eames Street, Wilmington, Massachusetts

WSL Woburn Sanitary Landfill

Calcium Sulfate Landfill Post Closure Monitoring Plan
MACTEC Engineering and Consulting, Inc., Project 6300060011/80.1

December 2006 Draft

FIGURES





TABLES

Table 1

Analyte Sampling Matrix - Calcium Sulfate Landfill Monitoring Wells Calcium Sulfate Landfill Post Closure Monitoring Plan 51 Eames Street Wilmington, MA

34				10 mg 10 mg 10		Mark IV			V.Y. 15 29	Date			1 N N N N	Man a	1		X	
ocation.	Parameter Type	5/19/1988	12/8/1988	5/1/1989	11/1/1989	5/1/1990	11/21/1990	12/10/1991	8/6/1992	8/10/1992	11/9/1992	12/17/1996	4/22/1998	4/23/1998	7/9/1998	3/15/2002	8/27/2003	3/12/2004
L-1D	Volatile Organics	2								36	36							5
	Semivolatile Organics	7				4				65	65						December 1	1
	Pesticides/PCBs						1			21	21							
	Field Parameters					2000				3	3	3			1			1
	Inorganics	3	3	3	3	3	3			3	3	3	8					1
	Metals, Dissolved	1	1	1		1	1			23	23	2	7					
	Metals, Total				1													
SL-2	Volatile Organics	2																5
	Semivolatile Organics	7				V.											1	1
	Pesticides/PCBs									80							ļ	
	Field Parameters											3	THE REPORT OF THE PERSON OF TH					1
	Inorganics	3	3	3	3	3	3					3	8				1	1
	Metals, Dissolved	1	1	1		1	1	×				2	7					
	Metals, Total				1		 											
SL-3	Volatile Organics	2																
	Semivolatile Organics	7				-	 	1										
	Field Parameters						<u> </u>	7-7-6-6-6				3					ŧ	
	Inorganics	3	3	3	3	3	3					3	8	-			ļ	
ACCOUNT OF	Metals, Dissolved	1 1	1	1		1	1 1					2	7					
	Metals, Total	····			1							- 4						
SL-5	Volatile Organics	2	i vi		· ·	n sale		36										
2	Semivolatile Organics	7						65									ļ	
	Pesticides/PCBs	-1		8	-			27		5012						Home-terminal		
-	Field Parameters	1 1										3	CORPORE CONTRACTOR OF THE CONT					
	Herbicides		7775									3						
	Inorganics	3		3	3	3	3	4										
	Metals, Dissolved	1		1	3	1	3	4				3	8					
	Metals, Total				1			23		-(8) 51 151 151 151		2	7					
SL-6	Volatile Organics							23	36	- 10								
	Semivolatile Organics								65		36							
	Pesticides/PCBs							mar v			65							
	Field Parameters								21		21							
	Inorganics	3	3	3	3	2	-		3		3	3			10 A TO 10 A T		201	
	Metals, Dissolved	1	1	1	3	3	3		2		3	3	8			8		
	Metals, Total		*			1	11		23	3	23	2	7					
L-7	Volatile Organics				1						- INCOME							
		-																
	Semivolatile Organics														A SAME A SOUTH			
	Inorganics					-							3	1	1			
L-8	Inorganics					-								1				

Notes

^{1.} Data in columns represents the number of analytes for each parameter type sampled and analyzed for.

Table 2 Analytes Detected at CSL Groundwater Monitoring Wells Calcium Sulfate Landfill Post Closure Monitoring Plan 51 Eames Street Wilmington, MA

	MCL	MMCL	ORSG	SMCL	Blind Duplicate MW-3	MW-03 MW-3	MW-05 MW-5	MW-08D MW-8D	SL-01-D SL-1D	SL-01-D SL-1D	SL-01-D SL-1D	SL-01-D SL-1D	SL1D SL-1D	SLID SL-1D	SL-01-D SL-1D	SL-01-D SL-1D	SL-01-D SL-1D	SL-1D SL-1D	SL-1 SL-1D	SL-02 SL-2	SL-02 SL-2	SL-02 SL-2	SL-02 SL-2	SL2 SL-2
Parameter Name	(mg/L)	(mg/L)	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	(mg/L)	4/29/1998 Duplicate	4/29/1998 Sample	4/29/1998 Sample	4/29/1998 Sample	5/19/1988 Sample	12/8/1988 Sample	5/1/1989 Sample	11/1/1989 Sample	5/1/1990 Sample	11/21/1990 Sample	8/10/1992 Sample	11/9/1992 Sample	12/17/1996 Sample	4/22/1998 Sample	3/12/2004 Sample	5/19/1988 Sample	12/8/1988 Sample	5/1/1989 Sample	11/1/1989 Sample	5/1/1990 Sample
Volatile Organics (mg/L)									Garripio	Campie	Cumple	Campic	oumple	Jampie	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample
1,2-Dichloroethane	0.005	0.008	5												< 0.005		ð l							11
1,2-Dichloroethene (total) 2,4,4-Trimethyl-1-pentene									< 0.01						< 0.005									
2,4,4-Trimethyl-2-Pentene									< 0.01						< 0.01 < 0.01					< 0.01 < 0.01				
Acetone			6.3			100 W									< 0.015					V 0.01	>			
Benzene	0.005	0.005	5											C =5-	< 0.005		9 19							
Bromoform Chloroform			0.07												< 0.005									
Methylene Chloride	0.005	0.005									-				< 0.005 < 0.01	< 0.005 < 0.01			0.000					
Tetrachloroethene (PCE)	0.005		5												< 0.005					<u>,</u>				-
Toluene	1	1	1									Tiesd			< 0.005	< 0.005								
Vinyl Chloride Xylenes, Total	0.002		-												< 0.01	< 0.01		Ö						
Semivolatile Organics (mg/L)	10	- 10	1			-		a		-			-	——	< 0.005	< 0.005								
1,3-Dichlorobenzene						2	-tason								< 0.01	< 0.01			300					
bis(2-EthylHexyl)phthalate	0.006	0.006	5						< 0.01						< 0.01	< 0.01				0.007				
Diethylphthalate Di-n-butylphthalate			1				-		< 0.01						< 0.01					< 0.01				
Di-n-octylphthalate				-					< 0.01 < 0.01					1	< 0.01 < 0.01					< 0.01 < 0.01				
N-Nitrosodimethylamine			0.00001					551-51 /	5.01						, 0.01	~ 0,01			< 2E-06	× 0.01			- K - S-	
Phenol Participation (POP)					572										< 0.01	< 0.01								
Pesticides/PCBs (mg/L) Beta-BHC																75.1							2	
Field Parameters (mg/L)			1												< 5E-05	7E-05								
Specific Conductance (umhos/cm)															200	194	382							
Temperature (°C)					77-27			1948/7311001							17	12.2								
pH (pH units)				6.5							5				5.2	6.3	4.78		5.36					Address of the same
Inorganics (mg/L) Bicarbonate alkalinity as CaCO3					394	- 388	14	290	-			4.0						10						
Bromide, Dissolved								230										10						
Carbonate Alkalinity as CaCO3	j. 30				< 5	< 5	< 5	< 5		Ð					1990		0	< 5						
Chloride	0.0	0.0		250	38	46	4.3	42	29	18	4.2	17	10	7	11	29	21.6	14.9		< 2	2.5	2.7	3.5	5 2.
Cyanide Nitrogen, Ammonia	0.2	0.2			- 27.6	30.6	< 0.5	25.8	0.62	0.51	< 0.1	0.22	< 0.1	< 0.1	< 0.1	< 0.1	< 0.04	0.00	0.004					
Orthophosphate as P					27.0	-00.0	1 0.0	20.0	0.02	0.51	0.1	0.22	, U.1	0.1	< 0.1	< 0.1	< 0.04	0.98	0.091	< 0.1	0.36	< 0.1	< 0.1	1 < 0
pH (pH units)				6.5	6.01	5.96		6.31	-52/1997									5.36		1				
Specific Conductance (umhos/cm) Sulfate as SO4				050	977	986	162	866			(1	(a) = =15==5	CACCOLLA COLLA					273					KS01	
Total Dissolved Solids (TDS)			-	250 500	53 574	36.2 531	36 176	40 498	330	150	38	160	130	74	68	72	127	109 194		120	92	100	240	5
Metals, Dissolved (mg/L)	- 1			- 000		Januare Co.	170	450										194						100
Aluminum, Dissolved				0.05								- VES			0.28	0.13				-			- 3	
Arsenic, Dissolved Barium, Dissolved	0.01	0.05													< 0.005			-						
Calcium, Dissolved	- 2	2				_00									0.036	0.022	- 44	44.0			3			
Cobalt, Dissolved				- 1										 	< 0.015	< 0.015		44.8						
Copper, Dissolved		1.3		1						Nacional Property of the Control of		11 - 8		-	< 0.025	< 0.025								
Iron, Dissolved Lead, Dissolved		0.045		0.3											< 0.025	0.039		< 0.03						
Magnesium, Dissolved		0.015		-						own Marcal					< 0.005 1.6	< 0.005 1.7		4.00						
Manganese, Dissolved				0.05		1 - 522 - 51113									0.18	0.1		1.89					. IV	-
Potassium, Dissolved															3.2	2.6		1.7						
Sodium, Dissolved Zinc, Dissolved			20												6	11		14.3						
Metals, Total (mg/L)				5											0.027	< 0.025								
Aluminum, Total				0.05									7											
Arsenic, Total	0.01										Column Column											000000000000000000000000000000000000000	24	
Barium, Total Calcium, Total	2	2			40.5		10.5				37				- 1									0.000
Chromium, Total	0.1	0.1			49.5 < 0.03	< 0.03		< 0.03				< 0.015											10002.50	
Cobalt, Total	0,1	0.1			- 0.03	- 0.03	- 0.03	0.03				V.U15			-				De				0.51	
Copper, Total		1.3		1											acute de la constant								CONSTRUCTOR OF	
Iron, Total		0.01=		0.3	< 0.03	< 0.03	< 0.03	0.425																Company to Section 1
Lead, Total Magnesium, Total		0.015			26.4	25.0	4 40	40.0			-													
Manganese, Total				0.05	26.1 1.9	25.6	0.021	12.2																
Nickel, Total			0.1	5,00		101	0.021	2.0.01			Transfer of the Control of the Contr					-								
Potassium, Total					26.7	26.6	1.6	10.6	k 6															-
Sodium, Total			20	n e eo 2	61	60.4	12.6	49.5	10000									***************************************	1					
Vanadium, Total Zinc, Total		-		-																				
				21											. 4	1								I The Street Street

Notes 26.7 Analyte detected 50 Analyte detected above regulatory standard or guidance value

Table 2 Analytes Detected at CSL Groundwater Monitoring Wells Calcium Sulfate Landfill Post Closure Monitoring Plan 51 Eames Street Wilmington, MA

			- 3		SL2	SL-02	SI 02	61.2	1140-SL2	61.2	61.2	61.02	CI 02	61.02	51.03	E1 2	61.2	61.02	El a	SI OF	CI OF	el ne	CI E	61.5
	1			pre 2 h	SL-2	SL-2	SL-02 SL-2	SL-2 SL-2	SL-2	SL-2 SL-2	SL-2 SL-2	SL-03 SL-3	SL-03 SL-3	SL-03 SL-3	SL-03 SL-3	SL3 SL-3	SL3 SL-3	SL-03 SL-3	SL-3 SL-3	SL-05 SL-5	SL-05 SL-5	SL-05 SL-5	SL5 SL-5	SL5 SL-5
	MCL	MMCL	ORSG	SMCL	11/21/1990	12/17/1996	12/17/1996	4/22/1998	3/15/2002	8/27/2003	3/12/2004	5/19/1988	12/8/1988	5/1/1989	11/1/1989	5/1/1990	11/21/1990	12/17/1996	4/22/1998	5/19/1988	5/1/1989	11/1/1989	5/1/1990	11/21/1990
Parameter Name Volatile Organics (mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	Sample	Duplicate -	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Sample
1,2-Dichloroethane	0.005	0.008	5																*****					
1,2-Dichloroethene (total)				13																				
2,4,4-Trimethyl-1-pentene 2,4,4-Trimethyl-2-Pentene	-											< 0.01 < 0.01			1					< 0.01 < 0.01				
Acetone	33		6.3									0.01								V 0.01				-
Benzene	0.005	0.005	5																					
Bromoform Chloroform	-		0.07																					ļ
Methylene Chloride	0.005	0.005														-								li .
Tetrachloroethene (PCE)	0.005	0.005	5		0.00																			
Toluene Vinyl Chloride	1 0,000	0.000	1				0.000000																	
Xylenes, Total	0.002	0.002																						
Semivolatile Organics (mg/L)		La constantes							,															
1,3-Dichlorobenzene											10												1	
bis(2-EthylHexyl)phthalate Diethylphthalate	0.006	0.006	5							-		< 0.01								0.005				
Di-n-butylphthalate						-				 		< 0.01 < 0.01			-					< 0.01 < 0.01				
Di-n-octylphthalate	-											< 0.01		*						< 0.01	~ - 2	degramma.ee		
N-Nitrosodimethylamine			0.00001							. < 2E-06	< 2E-06													
Phenol Pesticides/PCBs (mg/L)	-	-																		-			i i	-
Beta-BHC								31				1			-									
Field Parameters (mg/L)																					19			
Specific Conductance (umhos/cm)	1	89-					549											1000						
Temperature (°C) pH (pH units)		-		6.5			6.8 5.61				5.51				_			9.3 5.26					-	
Inorganics (mg/L)	-			0.5			5.01				3.51	V	5-		* s			5.20						1
Bicarbonate alkalinity as CaCO3						4 3	2001-121-21-21	< 5											26					
Bromide, Dissolved	1																							
Carbonate Alkalinity as CaCO3 Chloride	-			250	< 2	< 3	< 3	< 5 1.06	all state of the s	N		4.1	13	4.3	36	4.9	5.2	4.1	< 5 3.19	180	230	140	120	0 22
Cyanide	0.2	0.2		200				1.60				4.1		4.0	30	4.0	0.2	4.1	5.18	100	.200	140	120	22
Nitrogen, Ammonia					< 0.1	< 0.04	< 0.04	4.5		3	0.11	2.9	6.8	2.4	9.7	2.1	2.4	0.73	2.42	160	4.8	33	6.9	9 8:
Orthophosphate as P pH (pH units)	-			6.5	5			F 2				-							5.07	Domoeums Internal				ļ
Specific Conductance (umhos/cm)	-		-	0.5				5.3 147		0							1		5.37 775					
Sulfate as SO4				250	40	235	239	37.6				640	710	470	790	530	720	502			1100	1300	1300	0 130
Total Dissolved Solids (TDS)				500				< 50											406					
Metals, Dissolved (mg/L) Aluminum, Dissolved	-		-	0.05								(*2											110011-1110-21-	
Arsenic, Dissolved	0.01	0.05		0.00																				
Barium, Dissolved	2	2													1									
Calcium, Dissolved					0	79.3	81.7	18.2										175	143					
Cobalt, Dissolved Copper, Dissolved	-	1.3	3	1							0								-		- Zi		-	
Iron, Dissolved		,.0		0.3				< 0.03									y 0 0 0 1		0.051					
Lead, Dissolved		0.015	j .																197					
Magnesium, Dissolved Manganese, Dissolved	1			0.05				0.262 < 0.01		CONT. IN CONTROL OF THE									3.6 0.623					
Potassium, Dissolved				3.03				2.2											2.1					
Sodium, Dissolved			20					4.01						33					4.6					
Zinc, Dissolved				5	022-0-2																			
Metals, Total (mg/L) Aluminum, Total	+			0.05																				
Arsenic, Total	0.01	0.05		3.00		Constant are not taken													- 1					
Barium, Total	2	2																					(200)	
Calcium, Total Chromium, Total	0.1	0.4													. 0.015							4 000		5
Cobalt, Total	0.1	0.1													< 0.015				-			< 0.015		
Copper, Total		1.3		1			0.000 - 0.000 - 0.000			330000000000000000000000000000000000000		4	AN WASSE WHEN SERVICE											
Iron, Total				0.3																	CANCE - William	- C 7		
Lead, Total Magnesium, Total		0.015																						
Magnesium, I otal Manganese, Total	+			0.05								-	-		-									+
Nickel, Total			0.1						70															
Potassium, Total	, in																				server no			
Sodium, Total Vanadium, Total		// (Last Solice III)	20	_													A Second							
Zinc, Total	1			5							77													
												I	h		1		<u> </u>	-		1	THE THERE			_L

Notes 26.7 Analyte detected Analyte detected above regula

Table 2 Analytes Detected at CSL Groundwater Monitoring Wells Calcium Sulfate Landfill Post Closure Monitoring Plan 51 Eames Street Wilmington, MA

	MCL	MMCL	ORSG	SMCL	SL-05 SL-5 12/10/1991	SL-05 SL-5	SL-5 SL-5	SL-06 SL-6	SL-06 SL-6	SL-06 SL-6	SL-06 SL-6	SL6 SL-6	SL6-REP SL-6	SL6 SL-6	SL-06 SL-6	SL-06 SL-6	SL-06 SL-6	Blind Duplicate SL-6	SL-6 SL-6	SL-7	SL-7 SL-7	SL-8 SL-8
Parameter Name	(mg/L)	(mg/L)	(mg/L)	(mg/L)	Sample	12/17/1996 Sample	4/22/1998 Sample	5/19/1988 Sample	12/8/1988	5/1/1989	11/1/1989	5/1/1990	11/21/1990	11/21/1990	8/6/1992	11/9/1992	12/17/1996	4/22/1998	4/22/1998	7/9/1998	4/23/1998	4/23/199
olatile Organics (mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	Janiple	Sample	Sample	Sample	Sample	Sample	Sample	Sample	Duplicate	Sample	Sample	Sample	Sample	Duplicate	Sample	Sample	Sample	Sample
,2-Dichloroethane	0.005	0.005			< 0.005							-	-		< 0.005	< 0.005						-
,2-Dichloroethene (total)			105-02		< 0.005										< 0.005	< 0.005	- Very Very					
4,4-Trimethyl-1-pentene					< 0.01				77587777	- 1.7 50-90					< 0.001	< 0.00						
2,4,4-Trimethyl-2-Pentene					< 0.01						- TEXT				< 0.01	< 0.01		3:				
Acetone			6.3		< 0.015										0.008	< 0.015			10			
Benzene	0.005	0.005			< 0.005										< 0.005	< 0.005	Southern Comment					
Bromoform			0.07		< 0.005										< 0.005	< 0.005						
Chloroform Methylene Chloride	0.005	0.005	0.07	-	< 0.005										0.006	< 0.005						
Tetrachloroethene (PCE)	0.005	0.005		-	< 0.002 < 0.002										< 0.01	< 0.01						
Toluene	0.003	0.003	_	1	< 0.002		-						ļ .		< 0.005	< 0.005						L .,
Vinyl Chloride	0.002	0.002			< 0.01										< 0.005 < 0.01	< 0.005 < 0.01						
Xylenes, Total	10	10			< 0.005						1131333171		1		< 0.005	< 0.005			-			
Semivolatile Organics (mg/L)												077			V 0.005	\ 0.000						-
1,3-Dichlorobenzene		31184.11-1757			< 0.012		1								0.002	< 0.01						
bis(2-EthylHexyl)phthalate	0.006	0.006			< 0.012									-	0.001	< 0.01			-			
Diethylphthalate					< 0.012										< 0.01	< 0.01						
Di-n-butylphthalate					< 0.012									0-130	< 0.01	< 0.01						
Di-n-octylphthalate			0.0000		< 0.012										< 0.01	< 0.01						
N-Nitrosodimethylamine			0.00001		7 0.040								V	83						0.5		
Phenol Pesticides/PCBs (mg/L)				 	< 0.012										< 0.01	< 0.01						
Beta-BHC	-				< 5E-05																	
Field Parameters (mg/L)	 			-	~ 3E-U3		-								< 5E-05	< 5E-05	4					
Specific Conductance (umhos/cm)						2570									2000	0000	20.40					
Temperature (°C)				1 1		10.1								-	2000	2820 11.3	2340 10.5					
pH (pH units)				6.5		5.85							-		5.4		5.6					
Inorganics (mg/L)															0.4	. 0.1	3.0		-			-
Bicarbonate alkalinity as CaCO3							88									-		. 58	56			
Bromide, Dissolved									:1			244576500			1							
Carbonate Alkalinity as CaCO3	277						< 5		CENTRATORS									< E	< 5			
Chloride		-		250	160	28.9	23.4	88	91	86	110	160	180	. 170	400	680	57.6	26,6	27.6	-2-3/17/17/17		
Cyanide	0.2	0.2			0.053																	
Nitrogen, Ammonia Orthophosphate as P					86	79.3	50	84	20	26	27	23	34	33		180	70.9	55.4	57	< 0.5		
pH (pH units)				6.5			6.01															
Specific Conductance (umhos/cm)				0.5	-		2490											5.56				-
Sulfate as SO4	- 1			250	1300	1370	1190	370	930	1100	1100	1100	970	₩ 1000	1500	1400	956	3140 1370			10.4	
Total Dissolved Solids (TDS)		1		500		30-27-12	1700			1100	assent (OU)	2221100	1000000	- 1000	1500	1400	956	2050			10.4	4
Metals, Dissolved (mg/L)			51						1576555						1			2000	1930		Ø.	
Aluminum, Dissolved				0.05					0-200						0.39	0.12						1
Arsenic, Dissolved	0.01	0.05													< 0.005	< 0.005						
Barium, Dissolved	2	2							312						0.03	0.032						
Calcium, Dissolved						343	418								440	430	248	416	422	Commercial		
Cobalt, Dissolved		4.0													0.043	0,057						
Copper, Dissolved ron, Dissolved		1.3		1											< 0.025	< 0.025		and the state of				
_ead, Dissolved	-	0.015		0.3			0.037								< 0.025	0.034		< 0.03	< 0.03			
Magnesium, Dissolved		0,010		-			5.81								< 0.025	< 0.025						
Manganese, Dissolved				0.05	+		0.486								30	32		15.2				
Potassium, Dissolved		- 1		0.00			3.9	-						-	9.5 24	30	-	5.02				ļ
Sodium, Dissolved			20				47.8						-		280	390		12.2				
Zinc, Dissolved				5											< 0.025	< 0.025		4,00,4	.08.1			
/letals, Total (mg/L)															, 0,023	- 0,025						
luminum, Total				0.05	12			N. Carlotte														
rsenic, Total	0.01	0.05		nomento d	0.01							me ti batalan er										
Jarium, Total	2	2			0.077																	
alcium, Total					440			1	0 1													
hromium, Total obalt, Total	0.1	0.1			0.041						< 0.015					7.5						
opait, rotal opper, Total		1.3			0.021												E &					
opper, rotal		1.3	-	0.3	0.36									****			State of the state					
ead, Total	+	0.015		0.3	< 0.005								4									
lagnesium, Total		0.010		27.30	21		-															
anganese, Total		-		0.05	2.3								ļ									
ickel, Total			0.1		0.11									931				D.		-3000		
otassium, Total					11																	
odium, Total			20		100							-			-	1-1-			-			-
				**************************************	< 0.025							2										-
anadium, Total nc, Total	I.																					

26.7 Analyte detected
Analyte detected above regula

Brown highlighted cell with bold font indicates an exceedance of the MCL, MMCL, ORSG, or SMCL

Blue highlighted cell indicates the analyte was detected Value in italic font indicates the laboratory reporting limit is greater than the criteria

Table 3 Summary of Groundwater Elevations Calcium Sulfate Landfill Post Closure Monitoring Plan 51 Eames Street Wilmington, MA

Monitoring	Well	34.9	Groundwater Elevation														
Location	Northing	Easting	9/30/91	8/14/92	9/3/92	1/7/93	4/21/93	10/8/95	5/1/96	12/17/96	4/7/98	4/22/98	4/29/98	5/2/01	10/31/01		
SL-1D	555264.4	693229.8	80.40	79.01	78.98	82.06	83.07	78,40		83.22	81.51	81.49	1120,00	0/2/01	10/3 1/0 1		
SL-2	555159.1	693244.4	78.88		77.93	80.84	83.87	76.47	82.76	83.24	80.57	80.29	- 12	80.04	78.20		
SL-3	555090.1	693519.4	78.14		77.61	80.53	83,87	75.79	82.93	83.17	80.58	79.99	80.16	79.83	78.01		
SL-5	555414.3	693603.2	78.05		94.42	81.42	81.86	700 - 10 M	80.43	82.18	81.30	10.00	80.75	80.41	78.66		
SL-6	555479.8	693562.1	78.06	76.68	76.93	81.73	81.97	75.20	81.70	82.44	81.51	80.92	00.70	80.71	78.86		
SL-7	555538.6	693434.4	84.02		95.25	84.07	84.04	84.06	83.70		83.92	83.33	35/2570	83.39	81.56		
SL-8	555466.5	693376.4	92.40		92.40	87.73	86.38	86.81	86.86		86.18	87.31		92.40	86.17		

Table 4 Estimated Post Closure Montoring Costs Calcium Sulfate Landfill Post Closure Monitoring Plan 51 Eames Street Wilmington, MA

						Annua	l Costs						
Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	T	2018
Year Number	1	2	3	4	5	6	7	8	9	10	 11	t	12
Total Yearly Cost Item	\$ 8,951	\$ 3,699	\$ 2,401	\$ 3,699	\$ 2,401	\$ 3,699	\$ 2,401	\$ 3,699	\$ 2,401	\$ 3,699	\$ 2,401	\$	3,699
Annual Inspection- 3rd Party Review	\$ 300	\$ 300	\$ 300	\$ 300	\$ 300	\$ 300	\$ 300	\$ 300	\$ 300	\$ 300	\$ 300	\$	300
Baseline Quartery Monitoring	\$ 8,651				ž.								
Annual Monitoring		\$ 2,101	\$ 2,101	\$ 2,101	\$ 2,101	\$ 2,101	\$ 2,101	\$ 2,101	\$ 2,101	\$ 2,101	\$ 2,101	\$	2,101
Biannual Reporting - 3rd Party Review		\$ 1,298		\$ 1,298		\$ 1,298		\$ 1,298		\$ 1,298		\$	1,298

Total Cost (Current Dollars) \$ 43,152 Average Annual Cost \$ 3,596

Assumptions

Groundwater Sampling

Baseline Monitoring

Quarterly Year 1

Annual Monitoring Annually Year 2 and Beyond

Years Duration Covered (Yrs) Year Landfill Cover Constructed 1988 0 Monitoring and Maintenance 1988-2006 0-18 18 Remaining Post Closure Monitoring 2007-2018 19-30 12

P:\Projects\olinwilm\Olin Wilmington CERCLA\OEMI Tasks\Task 80.0 On-Going Activities\Task 80.14 Sulfate Lndfl Closure\Reports\PCMP\Draft\Tables\Table 4 Cost Estimate.xls

Appendix A
Example Inspection Form

LANDFILL INSPECTION SHEET

Facility Na	me:	Calcium Sul	fate Landfill			
Location:		51 Eames St	reet, Wilmington	n, Massa	chusetts	
Date of Ins	pection:		/20			
Monitoring	Well Condi	ition				
Well ID	Locked		Labeled		Comments	
SL-08	Yes	No	Yes _	No		
SL-07	Yes	No	Yes	No		12
SL-06	Yes	No	Yes	No	<u> </u>	
SL-05	Yes	No	Yes	No		
SL-03	Yes	No	Yes	No		
SL-02	Yes	No	Yes	No	a a second	
SL-01D	Yes	No	Yes	No		<u></u>
	3			·		
Landfill Co	mponent	Condition			Comments	
Access Roa	d	Soil Erosion	:YesN	0	4038 AU	and the second
					,	
Gate		Hinges			- Vee - 10 - 10 - 10 - 10 - 10 - 10 - 10 -	
		Locked:	YesNo		8	
Fence		Holes: Y	es No	de de		
		Other:			٠	
Vegetative	Cover	Soil Erosion	:YesNo)		
5	North Milde Maddie Friddin		::YesN		8 #	
			ows:Yes	2		
Drainage Sv	wales		:YesNo			
			: Yes N		N'	
Settlement	usica sa u cossensiva		Yes No) () () () () () () () () () (
			Water: Yes			
<u>.</u>					<u> </u>	
Inspector N	ame (Printe	d):	N			
Townson Townson States	errennenger i <mark>P</mark> an, anganggang <u>a a</u> n	×	D		99-14-1-15-1 -1	
Inspector Si	gnature:				Date:	

Use map below to locate areas of Erosion (E), Animal Borrow (AB), Vegetative Distress (VD), Holes in Fence (FH), and provide additional comments and descriptions



Appendix B Low Flow Groundwater Sampling Field Data Record

FIELD	DATA REC	ORD - LO	N FLOW G	ROUNDWAT	ER SAMI	PĻING					
PROJECT	Olin Corporation	n, Calcium Sulfate	Landfill PCMP	SAMPLE I.D	, NUMBER]	ROUND NO.	
EXPLORAT	TION ID:				SITE TYPE	=]	DATE	
TIME	START	ENI)		JOB NUMBE	R			1	FILE TYPE	
WATER L	EVEL / PUMP SI	ETTINGS	MEASU	REMENT POINT			10-30-00-0		<u>t</u> ::		
INITIAL DE			TC	P OF WELL RISER P OF PROTECTIVE (HER	CASING	PROTECTIVE CASING STIC (FROM GROU	KUP	FT	PROTEG CASING DIFFER	3 / WELL	FT
TO WA			FT WELL (TOR)	DEPTH		PID AMBIENT AIF		PPM	WELL	-EB	IN
FINAL DEPTH TO WATER FT SCREE					PID WELL PPM		WELL	YES N			
DRAWDO VOLU (initial -	JME	h) or x 0.65 (4-inc	GAL RATIO	O OF DRAWDOWN VO	DLUME I	PRESSURE TO PUMP		PS]	CASING	
TOTAL PUR (purge	GED		GAL].	0.00026 gal/milliliter	Se.	REFILL FIMER SETTING			DISCHA TIMER SETTING		
PURGE DA			ration (minates)	SPECIFIC		JETTINO .	-		PUMP		
TIME	DEPTH TO WATER (ft)	PURGE RATE (ml/m)	TEMP. (deg. c)	CONDUCTANCE (ms/cm)	pH (units)	DISS. O2 (mg/L)	TURBIDITY (ntu)	REDOX (mv)	INTAKE DEPTH (ft)	COMMENTS	
3								0		Annual Control of the	
											32
											- Contractor
										<u> </u>	-
										-	
			2						1		
	NT DOCUMENTA OF PUMP		TYPE OF TUBIN	G	TYPE	OF PUMP N	IATERIAL		TYPE OF BL	ADDER MATERIAL	
QE	ED BLADDER	1	TEFLON OF	R TEFLON LINED		POLYVINYL CHLORIDE				1	
	MCO BLADDER]	HIGH DENS	SITY POLYETHYLENE	OLYETHYLENE STAINLESS STEEL					-	
GE	OPUMP		OTHER			OTHER				200	
To Be Collected Alka	alinity S S fate lais (Ca, Al, Mn,Fe er er er er er er er er er		<u>NL</u> 232 254	DC 0/375.2	4 4 4	ESERVATION METHOD DEG. C DEG. C DEG. C INO3 to pH <	REQUIF 250 ml F 125 ml F 125 ml F	RED Poly Poly	SAMPLE COLLECTED Alka TDS Sulfa Meta	linity	
PURGE OF	SERVATIONS	G			L	OCATION S	KETCH				
PURGE WA CONTAINER			NUMBER OF GA GENERATED	LLONS						76 (2)	
NOTES			92 22				ra ra				
				3							
SIGNATURE	Ē.	15 3			\$8				122	MACT	EC

Calcium Sulfate Landfill Post Closure Monitoring Plan
MACTEC Engineering and Consulting, Inc., Project 6300060011/80.1

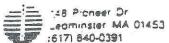
December 2006 Draft

Appendix C Well Construction Logs

(603) 882-3601

JOO NO. Dem 11/23/87 87-891 OLIN CHEMICAL _.ent CLIN CHEMICAL EAMES STREET, WILMINGTON, MA cation Type VI 27 Drilling Eng./Hyara. Das 11/11/87 11/11/87 Foreman D.C. P.N. Geologiel NO. Sulface Landfill SHALLOW #1 Sun Sample Date Soil and/or bedrock streta descriptions DIIK Casing Blows Strate Asc Sample 6" Penetracion Change Visual Identification of Soil and/or Rock Strate Depth (ft.) Por M. Medium still, motal organic bill, some 0'0"-1 0" 1 1'0"-2'0" 8-7 1'0" 1A Medium dense, dry to wet, fine SAND, 2'0"-4'0" 7-8-8-8 2 trace to some inorganic silt. 4'0"-510" 4-6 7'0" 5'0"-4 4-6-10-11 5 7'0"-9'0" 13-16-17-20 9'0" 9'0"- 10'0" | 46-70 6 90 Very dense, wet, fine SAND, and fine to 7 110'0"- 12'0" 164-34-27-35 coarse gravel, some inorganic silt, and medium to coarse sand, trace to some 8 112'0"- 12'9" | 58-120/3" cobbles, and boulders. 9 114'0"- 14'7" 53-120/1" :5 15'0" End of boring at 15'0" Set well point at 15'0" Water level at 5'6" upon completion 20 Well Materials: 2" PVC end plug 10' x 2" PVC screen x 2" PVC screen 5 * 2" PVC slip cap protective locking casing l bag - sakrete sand 2 bags - Portland cement 3 bags - silica sand 2 pails- bentonite pellets 30 l bag - bentonite powder 35 40 61 Hollow Stem Auger Steet: Type of Boring Casing Size: Cohestre Salls (Moure per R.) Granular Salls (bisses per ft.) Proportion Percentages 0 to 2 Very Set 8 to 15 Swif 30 to 50 Dense 0 to 4 Very Loose Trace 0 to 10% 2 5 4 Soft Over 50 Very Dense 15 to 30 Very Self 4 to 10 Looms Some 10 to 40% 4 to 8 Machine Sall 10 to 30 Medium Dense Over 30 Hard And 40 to 50% Standard penetration test (SFT) = 1400 hammer talling 30" Blows are per 6" taken with an 16" long x 2" O.D. x 1 316" I.D. split speen sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. If Moisture content indicated may be affected by time of year and water added during the driving process. If Water levels indicated may very with seasonal fluctuation and the degree of soil assuration when the boring was taken. If The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. If



SOIL EXPLORATION CORPORATION

23 'ngails 51 C30EC MM .sunssN 1036-288 (E03)

Geotechnical Drilling and Groundwater Monitor Wells Dam 11/23/87 37-891 LIN CHEMICAL OLIN CHEMICAL, , EAMES STREET, WILMINGTON, MA Trpe #2 SL-1D Cate Drilling Des 11/12/87 Engueryard Complete 11/12/87 P.N. D.C. NO.Sulface Landfill DEEP #1 Start Foreman Geologist Soil and/or bearack streta seachpoone Sample Deca Aec. Casing inches Bloss Chang Strate Samore Change 6° Penetration Visual Identification of Soil and/or Rock Strips 40 Depth (ft.) Per a Medium stiff, moist, organic Siif, son fine to medium sand, trace root metter . 101 2'0"-2-4-1'0"-8-7 2'0" 1'0" 2'0"-Medium dense, dry to wet, fine SAND, 4'0" 7-8-8-8 trace to some inorganic silt. 3 | - '0"-5'0" ١. 5'0"-7'0" 4-6-10-11 9'0" 113-16-17-20 7'0"-Very dense, wet, fine SAND, and fine to à.0.,- 10.0,, 9'0" 46-70 6 coarse gravel, some inorganic silt, and 7 110'0"- 12'0" 164-34-27-35 (1 medium to coarse sand, some cobbles and boulders. 12'6"- 113'6" 14 min./foot Run #1 NX CORED ROCK from 12'6" to 14'6". 12'6" 13'6"- 114'6" 17 min./100t Recovery 24"/24" = 100%. 15 14'6" End of boring at 14'6" Set well point at 14'6" Water level at 5'6" upon completion 20 Well Materials: 2" PVC end plug 10' x 2" PVC screen 51 x 2" PVC riser 2" PVC slip cap protective locking casing bags - sakrete sand 2 bags - Portland cement 3 bags - silica sand 2 pails- bentonite pellets 30 l bag - bentonite powder NOTE: Blows And Soil Descriptions Used From SL-IS (Shallow), 35 Per Client. 40 Type of Boring Caerng Sizer: Hollow Stem Auger Stee: 61 Cohestro Solle (bienes per R.) . Granular Salla (blows per ft.) Proportion Percentages 0 to 2 Very Soft 1 to 14 SW Trace 0 to 10% 0 to 4 Very Loose 30 to 50 Demes 2 to 4 Soft 15 to 30 Very Stiff Some 10 to 40% 4 to 10 Lones Over 50 Very Dense 4 to 6 Medium Sulf Over 30 Herd 10 to 30 Medium Dense And 40 to 50% Standard penetration test (SPT) = 1404 harmor falling 30°

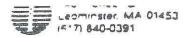
Blows are per 6° taken with an 18° long x 2" O.D. x 1 36° L.D. split spoon sempler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retinated attribute.

Mosture content indicated may be affected by time of year and water added during the drilling process.

Water tevels indicated may very with seasonal fluctuation and the degree of soil securation when the boring was taxen.

The stratification may be gradual.



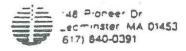
DUIL EAPLURATION CURPURATION Geotechnical Drilling and Groundwater Monitor Wells

Nashua, NH I3CEC (603) 882-360:

OLIN CHEMICAL Dama 11/23/87 -.001 JOD NO. 97-891 OLIN CHEMICAL, EAMES STREET, FILMINGTON, MA Type #2 51-20 BORING Date Drilling Engultyara. Complete 11/13/87 11/13/87 Foreman P.N. NO Sulface Landfill DEEP #2 D.C. Staff Geologie Sample Deta Soll ansiver begreek strette descriptions Acc Casing Inches Blows Sample Blows Streets 6° Penetration Change Visual Identification of Soil and/or Rock Street Depth (ft.) .10 LOOSE, MOISE, FIRE TO MEDIUM SAND, SOME OFFERIC SILE, FERCE FOOT METTER. 3'0"-1'0' 3-4-: '0"-2 . 0 .. 9-9 1'0" Medium dense, dry to wet, fine SAND, 3.5 ..-4'0" 5-7-7-6 trace to some inorganic silt. 6-7 31 4'0"-5'0" 5'0"-7'0" 7-10-10-12 7'0"-9'0" 10-14-11-15 9'0"- 10'0" 7-7 6 7 10'0"- 12'0" 6-9-9-8 ting to coerse stave Ahkow coerse an 12'0" 9 112'0"-12'10" 27-120/4" 13 0"- 114 0" 18 min./100t 13'0" 14'0"- 115'0" 21 min./100E Recovery 18"/24" = 75% 15'0" End of boring at 15'0" Set well point at 15'0" Water level at 5'7" upon completion Well Meterials: 2" PVC end plug 10' x 2" PVC screen 5' x 2" PVC riser 25 protective locking casing 1 bag - sakrete sand 1 bag - Portland cament 3 bags - silica send 2 pails- bentonite pellets 30 l bag - bentonite powder 35 :0 Type of Bonng Casing Suze: Hollow Stern Auger Size: 61 Proportion Percentages Cohestro Solla (blows per ft.) Granuter Sells (blows per ft.) Trace 0 to 10% 0 to 4 Very Loose 30 to 50 Dense 0 to 2 Very Soft A m 16 Sulf Some 10 to 40% 4 to 10 Longs Over 50 Yery Dones 2 to 4 Set 15 to 30 Very Striff And 40 to 50% 10 to 30 Medium Dense 4 to 8 Medium Stiff Over 30 Herd Standard ponerousn test (SPT) a 1404 harmor falling 30"

Blows are per 6" telean with an 16" long x 2" Q.D. x 1 36" L.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved services. Ill Moisture contains may be effected by time of year and water added during the drilling process. Ill Water tevels indicated may very with sessional fluctuation and the degree of soil seturation when the borning was causer. If The stratification lines represent the approximate boundance between and types, the actual transitions may be gradual.

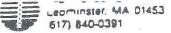


SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 -ngalis 5: Nasnua, Mm 23060 1036-538 (603)

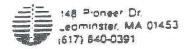
C.er	tien	CLIN CHEMICAL		REET	. EIL	MINGTON.	. AF.				
80A NO.5	ING 5015	Type #2 SL-1 are Landfill	DEEP #3 St	n 11.	/20/8	7 Compi	ione 11/20/87 Foreman P.N. Eng/hydrol. Geologist D.C.				
a.	-	Sam	p4s Deta				Sot and/or bedrock stress descriptions				
	No.	Sample Death (ft.)	Blows 6" Penetration	Aec Inches	Casing Blows Par R.	Strata Change Depth	Visual Identification of Soil and/or Rock Strate				
	1 :	0'0"- 0'6"	1-			0.9.0	TOPSOIL. Loose, moist, rine SAND, some inorgan;				
		2'0"- 2'0"		-		0 0	silt, trace root matter.				
		3'6"- 4'0"	3-3-4-								
£		3 0 - 4 0				3'6"	9				
• -	3 1	5'0"- 7'0"	9-11-11-12				Medium dense, dry to wet, medium to				
E (I	*				- 11	coarse SAND, some fine sand, trace				
	4	7'0"- 9'0"	15-10-8-12			- 11	inorganic silt, and medium gravel.				
						- 11					
0 _		10'0"- 12'0"	5-5-6-6		\vdash	(011					
	2	10.0 12.0	2-2-0-0			01	¥				
	51	12'0"- 13'6"	7-13-10-			: 1					
		13'6"- 14'0"	21			11					
						'					
1	7	15'0"- 17'0"	14-17-14-12			11	*				
	8	17'0"- 17'7"	29-120/1"			17:0"	Very dense, wet, fine to medium SARD, some medium to coarse gravel, and				
1 .	0.4	n #1 19'0"-	20'0" 6 =4	n./1	-	19'0"	some medium to coarse gravel, and inorganic silt, few cobbles and boulde				
9	Rui	20'0"-				19.0	Run. #1 NX CORED ROCK from 19' to 21'. Recovery 14"/24" = 58.32				
				25072		21'0"	End of boring at 21'0"				
							Set well point at 21'0"				
ļ							Water level at 12'6" upon completion				
=	-										
	-										
1	-+						Well Haterials;				
Ì	1	1				1	1 - 2" PVC end plug.				
1							1 - 10' x 2" PVC screen 1 - 10' x 2" PVC riser				
T							1 - 5' x 2" PVC riser				
1	-						1 - protective locking casing				
-	-						l bag - sakrete sand				
+							2 bags - Portland cament				
+	-+						2 bags - silica sand				
t	7						l pail - bentonite pellets				
							1 bag - bentonite powder				
			K.								
1						1					
26 6	of Bon	ing Casing Size:	Halia	w Stern	Auger !	Size:	4}				
Proportion Percentages Granular Selfs Trace 0 to 10% 0 to 4 Very Loses Some 10 to 40% 4 to 10 Loses And 40 to 50% 10 to 30 Medium Dense							Cohesive Selfs (bicum per R.) rese 0 to 2 Very Self 8 to 15 Self				
			Standard por	eraber	test (Si	PT) = 1400 ha	mmer talling 30° 2° Q.D. x 1 38° L.D. split spoon sempler unless otherwise noted.				



Nashua. Ym 13060 (603) 882-3601 [

LINGER	OLIN CHEMICAL				Dee 11/23/87 Job No. 87-891
DCX.	mon OLIN CHEMICAL	, EAMES STI	REET, WI	LMINGTON,	*A
IOA	ung Type #2 -SL-6 Sulface Landfill	D De	11/16/		Dollard Eng /hyerol
		ole Deta			Soil and/or bedrock strate descriptions
4	Sample No Depth (ft.)	Blows 6" Penetration	Acc Casen inches Blown Per ft	Chanca	Visual Identification of Soil and/or Rock Strate
	11 0'0"- 1'0"	1-2-			Loose, moist TOPSOIL.
	1A 1 ° 0" - 2 ' 0" 2 2 ° 0" - 4 ° 0"	3-4-4-4		1.0.	Loose, moist GYPSUM.
	5 7'0"- 7'8"	120/0" 15-29-31-36 41-120/2"		4.04	Very dense, dry, fine SAND, some mediu to coarse gravel, and inorganic silt, few cobbles, and boulders.
0 _	Rum #1 8'0"- 9'0"- 10'0"-	9'0" 3 min 10'0" 3 " 11'0" 5 "		8'0"	Run #1 NX CORED ROCK from 8'0" to 13'0 Recovery 14"/60" = 23.31 Weathered and many fractures.
		13'0" 8 "			97
5 _				13'0"	End of boring at 13'0" Set well point at 10'8" (Due to obstruction in core hole). No water encountered upon completion
0_					Well Materials; 1 - 2" PVC end plug 1 - 5' x 2" PVC screen 1 - 10' x 2" PVC riser
5 _					<pre>l - protective locking casing l bag - sakrete sand 2 bags - silica sand l pail - bentonite pellets</pre>
2					* * * * * * * * * * * * * * * * * * *
	3 4				
· _					
) _					
ngue e	of Bonng Casing Size:	Ha	Now Stem Aug	er Size:	41
	Proportion Percentages Trace 0 to 10% Some 10 to 40% And 40 to 50%	0 to 4 View 4 to 10 Lo 10 to 30 l	ry Leono	30 to 50 C Over 50 V	onse 0 to 2 Very Balt 8 to 15 Stell

The terms and percentages used to describe sell and or reck are based on visual identification of the restricted samples. If Melature content indicated may be affected by time of year and water added during the onling process. If Water levels indicated may very with seasonal fluctuation and the degree of soil securation when the bonng was taken. If The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. If



SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls 51 Nashua, NM 03060 (603) 882-3801

J. dit	A	THE RESERVE OF THE PARTY OF THE	ET UT	TVINCTON	Date 11/23/87 Job No. 87-891
BOB	ING Type #2 51-5	D Dage	11/17/		11/17/22 Onling Eng. Myord.
40.	Sulface Landfill	DEEP #5 Start	22/21/	Como	
5			Rec Cann		Soil and/or bedrock strets descriptions
) e	Sample No. Depth (ft.)	6" Penetretion In	Rec. Casing tiches Blows Per ft.	Change	Visual Identification of Soil and/or Rock Street
	2 2'0"- 4'0"	3-2-4-3 9-5-6-8			Loose to medium dense, dry to moist, fine SAND, some inorganic silt, trace medium to coarse sand, medium to coars
5 _	31:5'0"- 7'0"	3-3-5-4			gravel, wood, and blasted rock.
	4 - '0" - 7'5"	120/5"		7'0"	Very dense, dry to moist, fine SAND, and medium to coarse gravel, some
15_	5 10'0"- 10'7"	37-120/1**		9	inorganic silt, and medium to coarse snad, few cobbles, and boulders, trace weathered rock.
15 _	14.00- 11	The second secon	/foot /foot /} foot	And the second s	Run #1 NX CORED ROCK from 13'0" to 15'6' Recovery 23"/30" 76.6%
20 _				15'6"	End of boring at 15'6" Set well point at 15'0" No water encountered upon completion NOTE: Water at 14'6" after 24 Hours
				8	Well Materials; 1 - 2" PVC end plug
25					1 - 10' x 2" PVC screen 2 - 5' x 2" PVC riser 1 - protective locking casing
L 04	3			22	1 bag - sakrete sand 1 bag - Portland cement 2 bags - silica sand
-			21	2	l pail - bentonite pellets l bag - bentonite powder
35 <u> </u>		•		9	NOTE: This hole was a second attempt On the first attempt the hole went of
					due to blasted rock. Moved 4'0" forwar
0					
ype c	of Boring Casing Size:	Holow	Stern Augus	Siz:	41
II.	Proportion Percentages Trace 0 to 10% Some 10 to 40% And 40 to 50%	0 to 4 Very La 4 to 10 Laces 10 to 30 Medi	3800	30 to 50 De Over 50 Ver	nee 0 to 2 Very Self 8 to 15 Self
	3 13	Standard panels Blows are per 6	ration test (i	SPT) = 1400 ha h an 18" long x	mmer telling 30" 2" Q.D. x 1 38" L.D. split spoon sampler unless etherwise noted.

The terms and percentages used to describe soil and er recknew based on visual identification of the reineved samples.

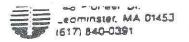
Melitary content indicated may be effected by time of year and water added during the drilling process.

Water levels indicated may very with treatment fluctuation and the degree of soil assuration when the boring was taken.

The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual.

2.100		OLIN CHEMICAL					Dam 11/23/87			
ا ا	non	OLIN CHEMICAL	L, EAMES ST	REET	. WIL	MINGTON.	MA			
ROB NO.S	NG ulf	Type #2 SE-	DEEP #6 Su	on 11	/18/8	7 Dame Comp	11/18/87 Dollarg P.N. Eng./Hydrol. D. Geologiet D.			
2		Sam	note Deta				Sail and/or begrock strate descriptions			
1 - 1 UITE)	No	Sample Depth (ft.)	Blows 6" Penerration	Rec. Inches	Casing Blows Per ft.	Stratz Change Depth	Visual Identification of Soil and/or Rock Street			
	1	0'0"- 2'0"	3-4-4-4							
							Loose, moist, fine SAND, some inorgan			
	2	2'0"- 3'0"	design the second secon	-			silt, trace blasted rock, medium to			
	2A	3'0"- 4'0"	5-4	-			coarse gravel, and organic silt, mixe			
5 _	3	5'0"- 7'0"	2-3-3-5				* * * * * * * * * * * * * * * * * * * *			
	-	7'0"- 9'0"	7-7-5-6	-		7'0"	Medium dense, moist, fine SAND, some organic silt, trace wood and root mat			
٠٥ _						9'0"				
۷_	5	10"0"- 12'0"	4-6-5-5			, ,	Medium dense, dry to moist to vet,			
						D	fine SAND, trace to some inorganic si			
	6	12'0"- 14'0"	6-7-7-8	-						
15	+			 						
.5 _	7.	15'0"- 17'0"	0" 35-30-31-44 14	14'6"	Very dense, wet, fine to coarse SAND,					
						2	some medium to coarse gravel, few			
							cobbles, and boulders, trace inorgani			
	5	n #1 19°0"-	2010" 8 -	40 11	oot	19'0"	Run #1 RX CORED ROCK from 19' to 21'.			
20 _	PCUI	20'0"-	Annual Street, and the Control of th	n./		19 0	Recovery 24"/24"			
						21'0"	End of boring at 21'0"			
							Set well point at 21'0"			
	-			-			Water level at 12'0" upon completion			
25	+			-						
						*	Well Materials;			
							1 - 2" PVC end plug			
- 1	_			-			1 - 10' x 2" PVC screen			
30	+			+	-		1 - 10' x 2" PVC riser			
İ	_				-		1 - 5' x 2" PVC riser 1 - protective locking casing			
Ī							l bag - sakrete sand			
							l bag - Portland cement			
15	-			-			3 bags - silica sand			
1	+			-	-		l pail - bentonite pellets			
Ì	+	-					bag - bentonite powder			
1										
40		•				*				
- 1										
Type			Holl		n Auger		41			
	2000	Trace 0 to 10%	0 to 6 Van			t (biows per R 30 to 50 D				
	9	Some 10 to 40%	4 to 10 Lo	000		Over 50 Ve	ry Dunee 2 to 4 Selt 15 to 30 Very Self			
	9	And 40 to 50%	10 to 30 h				4 to 8 Medium Staff Over 30 Herd			
			Standard po Blows are p	er (° la	n best (2 ben with	1 87 18" long :	errimer tailing 30" x 2" O.D. x 1 38" L.D. split spoon sampler unless otherwise noted.			

The terms and percentages used to describe soil and or rothere based on visual identification of the retrieved samples. It Molecuse content indicated may be effect by time of year and water added during the onling process. It Wester levels indicated may very with seasonal fluctuation and the degree of soil saturation when it borng was taken. It The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. It



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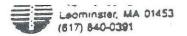
Cio@f		CHEMICAL			10 to 60	1100			B 11/23/8/	300 No. 87-891
Loca	mon OLIN	CHEMICAL	., EA	LMES STRU	EEI.	MIL	MINGTON,	AR		
EOR NO.	Sulface	Landfill	D DEE	P #7 Star	11	/19/	87 Comp	11/19/8	7 Foremen P.N.	Eng/hydrot. Geologist D.C.
2		Sarv	upte Dete	ľ				Soil and/	of bedrock street desc	notions .
1	40.1	Sampili Depth (fi.)	6° F		Inches	Casing Blows Per ft.	Stress Change Depth	Va	ual loamofication of Soil	andler Rock Strate
		0"- 1'9"					7	inorgani	few cobbles a	SAND, some medium to coarse and boulders, trace
š _		"- 5'1"	120/	7-120/10					a	
10	Rut. #1		9'0)" 6 m	Ln./			Run #1 M. Recovery	X CORED ROCK 28"/36" =	from 7'0" to 10'0" 77.7%
							10'0"	Set well	oring at 10'(point at 10' encountered	
15 _								Well Mat	2" PVC and p 5' x 2" PVC 5' x 2" PVC	screen riser
20 _		•					e 6	1 bag - 2 bag - 2 bags -	protective I sakrete sand Portland ces silica sand bentonita pe	ent
25 _					90.5		9 स्तु स	NOTE :	bentonite po	a second accempt. the hole was cored
30 _						2		2' to 5'	, with cobble	s and boulders.
35				•					is a	
								>	e	
40_							201 UV A 18 1	av _×		
None	of Bonng	Casing Size:		المراوا		n Auge	Sar	41		
. 7 (000	Proportie	n Percentages		2	0	der Sol	la (talous per l	ч		ve Solie (biove per R.)
	Some	0 to 10% 10 to 40% 40 to 50%		0 to 4 Very 4 to 10 Los 10 to 30 M			30 to 50 to Over 50 V		0 to 2 Very Belt 2 to 4 Set 4 to 8 Meeturn St	8 to 15 Self 15 to 30 Very Self Over 30 Hard
	ii.			Standard per Blows are pa		on test (3PT) = 1400 i h an 18" long	serviner talling 30" x 2" O.D. x 1 34	LO and spoon serve	aler unless otherwise noted.

The serms and percentages used to describe soil and or rock are based on visual identification of the serieved semples.

Molesure consent indicated may be effected by one of year and water added during the drilling process.

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Nashua, NH 3306-

OLIN CHEMICAL Dama 11/23/87 Cheril JOO No. 87-891 OLIN CHEMICAL, EAMES STREET. WILMINGTON, MA Location BORING LYPE # Z SL-ED Engultyaral. D.C Datting Dam 11/19/87 Complete 11/19/87 Foremen P.N. MOSulface Landfill DEEP #8 Geologist Samole Deta Soil and/or beorock stretz descriptions Rec. Casing Inches Blows ō Sample Strata Blows 6" Penetration Change Visual Identification of Soil and/or Rock Strata Decta (fL) Per ft. Medium dense, dry, time SAND, some medium to coarse sand, fine gravel, 0'0"-2'0" | 5-7-11-9 31 trace cobbles, root marrer, inorganic and organic silt, (fill) 3.0.. 3'0"-4 000 4 min /fopt Run #1 NX CORED ROCK from 3'0" to 6'0" 5 0" -'0"-7 min /foot Recovery 26"/36" = 72.2% 5 . 5'0"-6'0" 9 min /fopt Fractures. 6'0" End of boring at 6'0" Set well point at 6'0" No water encountered upon completion 10 Well Materials; 2" PVC end plug 1 5' x 2" PVC screen 5' x 2" PVC riser 15 buffalo box sakrete sand bag - silica sand pail - bentonite pellets 20 25 30 35 40 Type of Boring Coung Star. Hollow Stem Auger Size: Proportion Percentages Granular Solls (blows per R.) Sells (blows per ft.) Trace 0 to 10% 0 to 4 Very Loose 30 to 50 Dense 0 to 2 Very Built 8 to 16 300 4 to 10 Loose 2 to 4 to Some 10 to 40% Over 50 Very Dones 15 to 35 Very Sulf And 40 to 50% 10 to 30 Medium Derse 4 m C Man Over 30 Hard Standard penatration test (SFT) = 1400 haramer falling 30" Blows are par 6" tales with an 16" long x 2" Q.D. x 1 360" LD. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samplies. If Moisture consent indicated may be affected by time of year and water added during the drilling process. If Water levels indicated may very with seasonal fluctuation and the degree of soil setunation when the borning was taken. If The stratification first represent this approximate boundaries between soil types, the actual transitions may be gradual. If